IN THE SPECIFICATION AND CLAIMS

Amend the claims and specification as shown on the attached FIRST AMENDMENT: Marked up. A clean copy of the specification is also enclosed as FIRST AMENDMENT: CLEAN.

IN THE DRAWINGS

Amend drawing Figure 1b as shown in the informal replacement drawing sheet.

Informal replacement sheets are provided for both original sheets, in accordance with Examiner's objections to the drawings in the Office Action.

REMARKS

Reexamination and reconsideration of this application as amended is requested. By this amendment: Claims 3, 5, 8-10, 12, and 13 have been canceled; Claims 1, 2, 4, 6, 7, and 11 have been amended; and new independent claim 14 and new dependent claims 15 and 16 have been added. Claims 1, 2, 4, 6, 7, 11, and 14-16 remain in the application.

In the Specification:

Numerous amendments have been made throughout for clarity. Some paragraphs have been re-ordered, therefore paragraph numbers are no longer consecutive.

In the BACKGROUND section, some unneeded material has been deleted. Some sentences and chemical formulas have been re-written to be easier to read or to resolve ambiguity.

In amended paragraph 0022, the addition of "Granules of ... glass are typically packed into a mold..." is supported by paragraph 0026 of the original application.

Amended paragraph 0024, addition of "to melt them together" is supported by paragraph 0022 of the original application.

Amended paragraph 0026, replacement of "top surface" of the mold by "floor" is supported by Figures 1a and 2e, which show the glass granules in contact with a top-facing surface that could alternatively be called a floor, as it is lower than the enclosing frame members and supports the glass body. The purpose of the change is to avoid potential confusion between the supporting "floor" and the upper edges of the frames, which could also be seen as the "top surface" of the mold.

Paragraph 0027, addition of "Conventionally, the loaded mold is heated at a constant rate..." is supported by paragraph 0042 of the original application. "Al.sub.2O.sub3" is replaced with "alumina", which is generally well-known as the common name of Al_2O_3.

Paragraph 0028 has been deleted from this section because it refers specifically to the present invention and is not prior art.

Paragraph 0014, addition of "Crystallized glass...could be a desirable material for flooring...Glass ceramic is beautiful and durable. Floors of polished stone...especially if any oil or moisture are present. There is thus a need for ... even when wet." is supported by original paragraphs 0016, 0017, and 0030.

Similarly, amendment to paragraph 0032 is supported by original paragraphs 0016, 0017, and 0030.

Paragraph 0033, addition of "After polishing...craters that are about 0.2 to 0.5 mm deep" is supported by original paragraph 0052.

Paragraph 0034, addition of "The raised areas are typically about half as high as the original thickness of the precrystallized glass" is supported by original paragraph 0065.

Paragraph 0036, addition of "–Prior Art—" to Figure 1b is supported by paragraph 0012 "As a result, the crystallized glass [*of prior art*] has inherited the smooth and glossy characteristic of glass" compared to original paragraph 0037 "FIG 1c illustrates that to control the flow deformation...creates a non-smoothed surface" which refers to the present invention.

That is, the smooth surface shown in Fig 1b is clearly representative of prior art crystallized glass. The applicant stated several times in the original application, such as in paragraph 0033, that the point of the present invention is to "to control the flow deformation process to obtain the embossed surface." Therefore, Figure 1b cannot be illustrative of the present invention.

In amended paragraph 0043, addition of "liquidus temperature" is supported by original paragraph 0028.

Amended paragraph 0046, addition of "such as by water granulation" is supported by original paragraph 0022.

Paragraph 047, addition of "such as alumina powder" is supported by paragraph 0027.

Paragraph 0050, addition of "approximately 40 minutes" is supported by paragraph 0060.

Paragraph 0051, addition of "such that the spaces...not completely flattened down" is supported by paragraph 0042 and original claim 1.

Paragraph 0052, addition of "such that...0.2 to 0.5 mm is produced" is supported by paragraph 0064.

Paragraph 0060, addition of "liquidus temperature" is supported by original paragraph 0028 and addition of "approximately 40 minutes supported by original paragraph 0065.

Paragraph 0062, addition of "such that a textured surface... is produced" is supported by paragraph 0065.

In the claims:

Claims 1-13 were rejected as unpatentable over **Hashibe** in view of Nakamura and further in view of Kurahashi.

The **Hashibe** patent (USPN 5089345) discloses a crystallizable glass article with a flaky "surface layer 14" that is created by loading flakes of shattered crystallizable glass (column 2, lines 17,18) into a mold, then adding small balls of glass to the mold to cover the flaky pieces.

The Hashibe reference is not relevant to the present application because it teaches a crystallized glass article that is heat treated in a mold, then inverted for use. What Hashibe calls "surface layer 14" is composed of the "flaky pieces 11" that are in the bottom of the mold in FIG. 1.

The present invention comprises methods for producing a crystallized glass panel with a top surface suitable for flooring. The top surface of the finished panel is also the top surface during heat treatment.

Whether the crystallized glass article is held right side up or inverted during heat treatment step(s) is not simply arbitrary. Grain deformation while soft depends upon gravity, a directional force. Contact between the mold floor and the lower surface of the glass body produces mechanical constraints on the lower surface that the upper surface does not experience. The mold may act as a heat sink, a radiative heat shield, or both. Thus, the portion of the glass body in contact with the mold floor may experience a temperature profile that is different from that experienced by the exposed upper surface.

Therefore, even if Hashibe's methods and materials were more similar to those of the present invention, the results could be markedly different.

Hashibe refers to surface layer 14, also called "primary surface" (column 2, line 54), as having "an irregular rough surface pattern such as the scalelike or squamous pattern." (column 2, lines 53-55).

It seems unlikely that Hashibe's squamous flaky surface, including overlapping flakes, would be suitable for walking on, or for any use that potentially includes contact.

Hashibe's glass body as shown in FIG. 1 has large voids where the flakes overlap. Hashibe states that the *layer* "adjacent to said surface layer 14 is composed of small masses of the crystallized glass which are fusion bonded together and to the surface layer 14.

"In the crystallized glass article of the present invention [*Hashibe continues*], the small masses such as balls or coarsely ground masses are used together with the flaky pieces so as to form a densified or non-porous *layer* in the resultant crystallized glass plate" (column 2, lines 56-64, italics added).

(Examination of FIG 2 shows that it is apparently an error that the printed reference identifies the "*layer*" adjacent surface layer 14 as numeral 15. Numeral 15 was previously used to identify "flaky... pieces" in line 52. It is believed that the *layer* referred to above should have been identified as layer 16.)

Hashibe does not teach that surface layer 14 is non-porous or that it would be desirable that it be so. It does not appear likely that visual inspection of Hashibe's produced glass article 13 would reveal large voids under the flakes. Thus, not only the projecting edges of flaky pieces 15 would make the article unsuitable for contact, unseen voids below surface layer 14 could result in significant damage to article 13 if it were used for flooring.

This macro-porosity is a disadvantage of Hashibe's article whether the article is used inverted, with surface 14 uppermost, or in its manufactured orientation with surface 14 downward.

A further disadvantage of Hashibe's method is that the "primary surface" is in contact with the mold release agent during heat treatment. It is likely that the "alumina or zirconia sheet 24" would frequently stick to or react chemically with the crystallized glass article, making primary surface 14 unsightly in a certain percentage of cases.

Specifically considering claim 1, the Office Action states "Hashibe also specifically notes that the heating is carried out at a temperature above the softening point such that the glass particles deform to produce a dense, non-porous body. This deformation is understood to be equivalent to the assertion in claim 1 where 'the glass flow on the surface fills in all the spaces among the fusion-bonded glass bits' thus forming a dense or non-porous body."

Hashibe teaches in example 1, column 3, lines 18-22, that "the heat treatment was performed at about 1,100° C. in a furnace for about one hour to fusion-bond the flaky pieces and the balls together with one another and to simultaneously crystallize the flaky pieces and balls." No additional heat treatment step is disclosed.

Some of the terminology used in the production of crystallized glass articles seems confusing at first. "Fusion" has various common meanings, including nuclear fusion. Perhaps the most common meaning of fusion in chemistry is melting, that is, becoming liquid at a certain combinations of temperature and pressures, known as "liquidus conditions." For example, **Nakamura** uses "fusion" in the sense of melting in his patent 3,964,917, where it is taught to prepare crystallizable glass granules by "fusing" mixed raw ingredients such as nitrates and carbonates at 1440° C. It is clear that Nakamura means melting when he further states that "the fused glass was poured into a die" (column 1, lines 50-57).

However, in crystallized glass technology, "fusion" often refers to a certain solid-state reaction. Small granules attach, or "fuse" to each other, beginning at temperatures as low as 850° C. at standard pressure. To accomplish both grain fusion and crystallization in an efficient single step, Hashibe teaches heat treatment at 1100° C.

To make things a little more confusing, Hashibe teaches that his heat-treatment temperature of 1000-1200° C. is "higher than the *softening* point of the crystallizable or crystallized glass, so that each of the crystallizable glass pieces and balls is crystallized as well as *softened and deformed* to fusion-bond to one another..." (column 2, lines 45-48, italics added).

This deformation, or slumping, due to being softened is not the same as the technical term "flow deformation" that Applicant uses to mean a process that includes flow of liquid glass.

One of reasonable skill in the art of crystallized glass could be expected to be familiar with these different meanings of "fuse" and "deform" and would understand from a context which meaning is intended.

Hashibe never states or suggests that a liquid phase is created or flows. Nor does Hashibe teach the necessity of heating to above the liquidus temperature. Nor does Hashibe teach that control of flow is important to obtaining a nonslippery surface texture, as Applicant does in paragraph 0033.

In contrast to the Hashibe reference, amended claim 1 claims a dual heat treatment. The first heating step is "Heat-treating the loaded mold at a temperature below the liquidus temperature so all the individual small glass bits are fusion bonded and crystallize internally;" which is roughly equivalent to Hashibe's heat treatment.

But additionally, amended claim 1 claims a second heating step of **"Heat-treating the loaded mold at liquidus temperature, so the liquified glass flows to fill in voids among glass bits."**

In the examples disclosed in the specification, the applicant teaches that the fusion/crystallization step may be performed at 1115° C. and the second, flow deformation step may be performed at 1135° C.

Hashibe does not teach nor suggest a flow deformation process at or above the liquidus temperature of the system. Hashibe does not teach that any heat process is needed after crystallization is completed.

The Office Action states that it would be obvious to use one of the formulations taught by Nakamura (USPN 3964917) and process it at Hashibe's maximum disclosed temperature of 1200°

C. If a practitioner did process a Nakamura formulation having a liquidus temperature of less than 1200° C. using Hashibe's single-step process, it is true that flow deformation would occur.

Nakamura teaches in column 1, lines 59-61 that all the formulations disclosed in the TABLE spanning columns 3 and 4 were heat treated in a single step at 1150° C. for two hours.

However, neither Hashibe nor Nakamura teach that it is important to control the temperature and duration of flow deformation to avoid flattening of the surface glass granules, nor is it obvious from a combination of the references that flow deformation can be more precisely controlled by using a two step method.

Applicant, however, specifically claims in amended claim 1 a further step of "Interrupting flow deformation before all the individual glass bits have flattened, such that the cooled body will have a top surface with bumps with height greater than 0.5 mm."

Applicant explains in paragraph 0045 that one purpose of the first, sub-liquidus, heat treatment is to equilibrate the glass body near the liquidus temperature, so that increasing the temperature to at or above the liquidus for the second step will result in immediate flow deformation throughout the body.

The conventional technique for heat treating crystallized glass includes increasing the temperature of the furnace linearly until the crystallization temperature is reached. For example, **Nakamura** teaches a heating rate of 120° per hour to reach 1150 ° and Kurahashi et al. (USPN 5403664 and cited in paragraph 0009 of application as originally filed) teach an optimum heating rate of 60 ° per hour to reach the single stage heat treatment temperature, which is then held for two hours.

Nakamura's heating rate of 120 ° per hour cannot result in the careful control of flow deformation that the method of the present invention teaches and claims. This linear increase of temperature directly to the liquidus would probably result in flow deformation commencing at the corners of

the glass body first, followed by one or more of the sides, depending upon the type of furnace employed and the material of the mold.

Applicant's two-step heating method allows flow deformation to commence as simultaneously as possible throughout the glass body.

A linear heating rate directly to the maximum process temperature can also be expected to cause overshooting of the target temperature, quite likely in the exposed upper surface of the glass body. This upper surface is precisely the part of the body where Applicant wishes to control flow deformation most carefully.

Neither Hashibe nor Nakamura, nor both in combination, suggest or teach that a fusion/crystallization process should be followed by a higher temperature flow deformation step.

Neither Hashibe nor Nakamura, nor both in combination, teach or suggest creating a non-slippery upper surface on a glass body by control of a flow deformation step.

Neither Hashibe nor Nakamura, nor both in combination, teach or suggest that it is desirable to use the upper surface of a crystallized glass panel as the functional surface, suitable for being walked upon.

For these reasons and in light of the amendments to claim 1, Claim 1 is seen to be in condition for allowance and allowance is requested. Claim 1 is hereby amended for clarity and with addition of the limitation "Interrupting flow deformation before all the individual glass bits have flattened, such that the cooled body will have a top surface with bumps with height greater than 0.5 mm." The added subject matter of bumps with height greater than 0.5 mm is supported by paragraph 0064, which states that the finished panel has craters of 0.2 to 0.5 mm in depth even after polishing.

Amended dependent claims 2, 4, and 6, dependent upon now allowable claim 1 and reciting further

patentable subject matter, are seen to be allowable and allowance is requested.

Claim 6 has been amended by addition of subject matter: "such that a textured surface having a nominal flat surface and unpolished craters with a depth of 0.2 to 0.5 mm is produced." which is likewise supported by paragraph 0064 of the specification.

Referring specifically now to independent claim 7, claim 7 was rejected as unpatentable over Hashibe in view of Nakamura and further in view of Kurahashi.

The arguments above in support of claim 1 also apply to claim 7.

Additionally, amended claim 7 claims flat pieces of crystallized glass placed on the floor of the mold under the crystallizable glass bits to create an embedded pattern of raised areas in the finished panel.

As shown in Figures 2a through 2d, a glass body composed of small crystallizable glass bits of a variety of diameters as is characteristic of water granulation, shrinks 40% to 60% during the heat treatment steps of the present method. This is due mostly to ejection of the air-filled spaces found in the initial charge of glass bits in the mold. Grain fusion and flow deformation lead to a nearly solid glass body, with few or no voids. The crystallization of the glass grains increases the specific density of each grain slightly, also causing slight shrinkage and density increase of the glass body.

As shown in Figures 2e and 2f, the flat pieces of glass do not shrink appreciably. This is because the flat glass pieces do not include air initially.

This difference in shrinkage between the mass of glass bits and the flat glass pieces is what creates the raised areas over the flat pieces, as shown in Figure 2f.

Because the shrinkage and density change due to crystallization is small compared to the

shrinkage caused by grain fusion and flow deformation among the small glass bits, the method of claim 7 would create raised areas in the upper surface whether crystallizable or pre-crystallized flat glass pieces were employed. However, to more clearly distinguish claim 7 from the Hashibe reference, claim 7 has been amended to cite only *crystallized* flat glass pieces and reference to "crystallizable glass pieces" is deleted.

Neither Hashibe nor Nakamura, nor both in combination, suggest or teach embedding crystallized flat glass pieces under the glass body consisting of small crystallizable glass bits in order to create raised areas on the opposite surface of a finished glass article.

Neither Hashibe nor Nakamura teach or suggest creation of raised areas on the functional surface of a finished glass article in order to increase the coefficient of friction of the surface.

For these reasons and in light of the amendments to independent claim 7, Claim 7 is seen to be in condition for allowance and allowance is requested.

Amended dependent claim 11, dependent upon now allowable claim 7 and reciting further patentable subject matter, is now in condition for allowance and allowance is requested.

New independent claim 14 is hereby added. Claim 14 is similar to independent claim 7 except that the flat pieces placed on the floor of the mold are described as "flat pieces of a material that does not substantially change in density as a result of heat treatment ". This is supported by original claim 10, now canceled, which said that flat pieces "are not limited to be any form of glass materials so long as its density do not change in process."

New dependent claims 15 and 16 are hereby added. The subject matter of new claim 15 is supported by paragraph 0055. The subject matter of new claim 16 is supported by paragraph 0065.

The Examiner is requested to contact the undersigned at 619-234-4034 or (mobile) 760-529-1713 if it will aid in the disposition of this application. Thank you.

Sincerely,

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